On the Laws which regulate the Polarization of Light by Reflection from transparent Bodies. By David Brewster, *LL.D. F.R.S. Edin. and F.S.A. Edin. In a Letter addressed to the Right Hon. Sir* Joseph Banks, *Bart. K.B. P.R.S.* Read March 16, 1815. [*Phil. Trans.* 1815, *p.* 125.]

Though Huygens, who first explained the laws that regulate the extraordinary refraction of light at a surface of Iceland spar, discovered that light thus separated has properties different from common light; and though Newton observed that light thus modified has permanent properties, with reference to the plane in which it has been refracted, and expressed this peculiarity by saying that these rays have sides according to which its subsequent refractions are regulated;—it was Malus who gave to this modification the name of polarization, a term by which he could conveniently express the various affections which such light undergoes by refraction or reflection in different directions; and could thereby most distinctly describe the various phenomena relating to his important discovery, that light may also by reflection acquire the same properties that are given by refraction through Iceland spar and other doubly refracting crystals.

Malus ascertained, that when light is incident on the surface of water at a certain angle, that portion of it which is reflected is completely polarized; and that when light is incident on the surface of other media, the angle at which complete polarization of the reflected portion takes place will be different, being greater when the reflecting substance has a higher refractive. But Malus did not succeed in detecting the rule by which the requisite angles of incidence for different bodies could be inferred from their refractive powers.

Dr. Brewster has been more successful in this inquiry; and the result of his observations now communicated is, that the angles of incidence at which the maximum of polarization is affected by all substances he has examined are such, that tangent of incidence is to radius as sine of incidence to sine of refraction; or as he expresses it, tangent of incidence is equal to the index of refraction.

And since tangent is : radius :: sine : cosine, it is evident that the angle of refraction is then complement to the angle of incidence, or their sum is a right angle; and hence the reflected ray forms a right angle with the refracted ray.

At emergence also from a dense medium, the part reflected will be more or less polarized, and the maximum of polarization will be found as before, to occur when the angles of incidence and emergence are complementary to each other, or when the reflected portion makes a right angle with the refracted ray. Hence, in polarization by a plate of glass, of which the surfaces are parallel, if the incidence on the first surface be such as to polarize the reflected ray, the portion reflected from the second surface will be polarized at the same time,—a fact which Malus had observed, but acknowledged himself unable to explain.

Dr. Brewster further observes, that it is according to the same

law that the maximum of polarization takes place in reflection from the joint surface of two media. The angle of incidence is complement to the angle of refraction, or the tangent of incidence (as the author expresses it,) is equal to the quotient of the indices of refraction of the media.

After describing in a series of propositions the various degrees in which light becomes polarized by reflection or refraction at different angles, and the number of reflections or refractions necessary to effect complete polarization at various angles remote from that which produces the maximum, the author investigates the origin of a certain quantity of unpolarized light which exists even at the maximum polarizing angle in reflection from substances of high refractive power; and he shows it to depend on the different refrangibility of differently coloured light. For when the incidence is such that the mean refrangible rays are completely polarized, it is evident that the incidence will not be such as to polarize completely either the red or the violet rays, and consequently a beam composed of these will appear as white light not polarized; and when the polarization is effected at the surface of substances of high refractive and dispersive power, this portion will form a large proportion of the whole reflected light. On the contrary, any pencil of homogeneous coloured light, though only once reflected, may be completely polarized, even at the surfaces of the densest substances, if incident at an angle correctly adapted to its refrangibility.

The author purposes, on some future occasion, to point out the laws which regulate the polarization of light under various other circumstances not noticed in the present communication.

On some Phenomena of Colours, exhibited by thin Plates. *By* John Knox, *Esq.* *Communicated by the Right Hon. Sir* Joseph Banks, *Bart. G.C.B. P.R.S.* Read April 6, 1815. [*Phil. Trans.* 1815, *p.* 161.]

It is not surprising, says the author, that neither Sir Isaac Newton, nor Dr. Herschel, nor any other writer who has followed on the same subject, have given any explanation which appears to him to be satisfactory, since they have not been in possession of the phenomena connected with this inquiry. After stating various objections which he considers as conclusive against the alternate disposition to be reflected or transmitted inherent in the rays of light, and recurring at certain equal intervals which are expressed under the name of fits by Sir Isaac Newton, Mr. Knox proceeds to describe those new phenomena which form the principal subject of his paper, and which he has been enabled to make by the assistance of the method of observing such appearances employed by Dr. Herschel. This method consists in using the shadows of some opake substance held over thin plates of glass, for the purpose of distinguishing from each other the several effects produced by different surfaces employed at the same time. If a plate of unsilvered glass be laid upon a table before